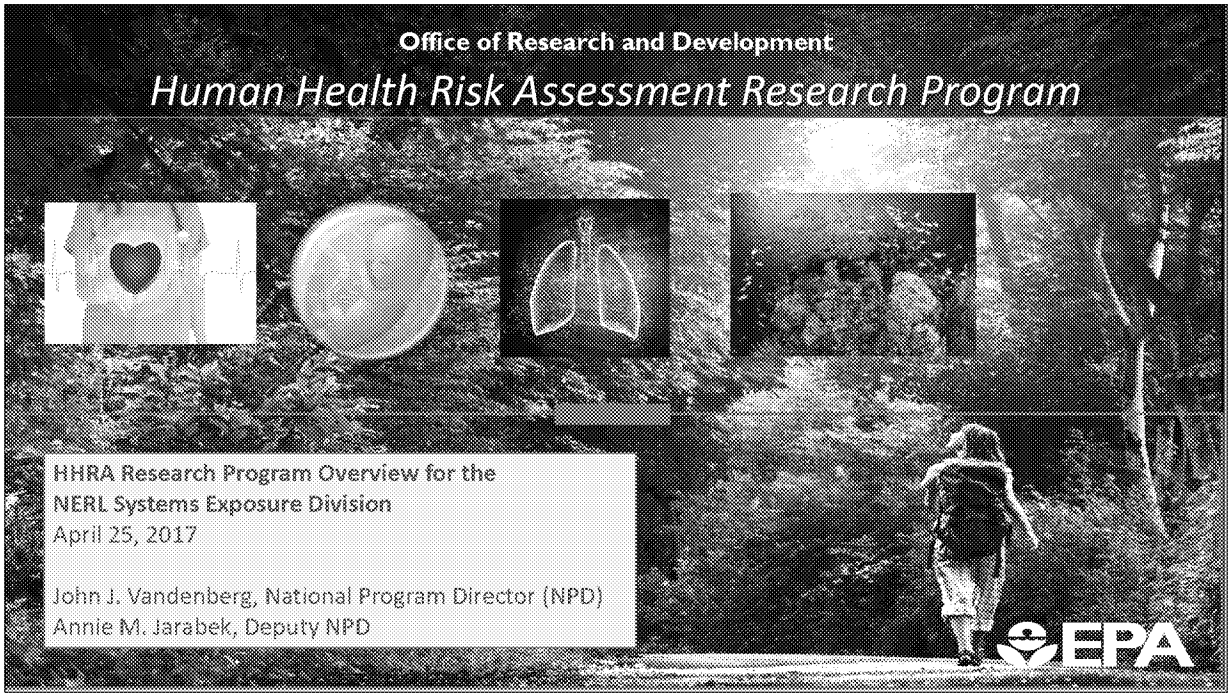
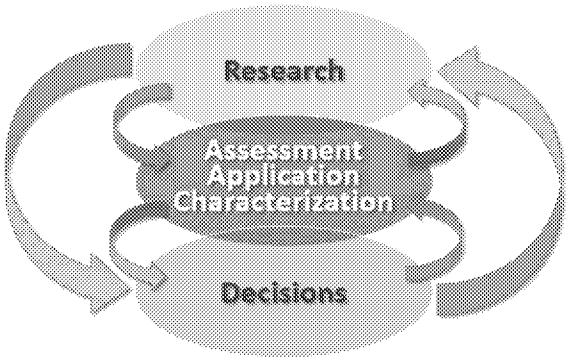

Office of Research and Development
Human Health Risk Assessment Research Program
HHRA Research Program Overview for the
NERL Systems Exposure Division
April 25, 2017
John J. Vandenberg, National Program Director (NPD)
Annie M. Jarabek, Deputy NPD
EPA

Overview Outline

- Program design
- Projects and tasks
  - Purpose
  - People
- Summary

HHRA: Pivotal Role in ORD Portfolio

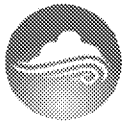


HHRA Vision: *Risk-based decisions by the EPA, State/local/tribal agencies and the public to protect public health and the environment are based on reliable, transparent and high-quality risk assessment methods, models, and data.*

HHRA Addresses all Agency Priorities and Mandates

HHRA

- Clean Air Act (CAA)
- Safe Drinking Water Act (SDWA)
- Food Quality Protection Act (FQPA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Resource Conservation and Recovery Act (RCRA)
- Toxic Substances Control Act (TSCA)

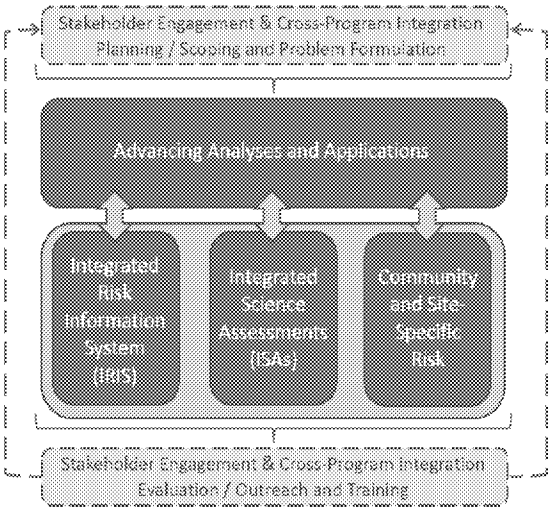


Broad Input to Support

- Agency Strategic Goals
- Children's Health, Environmental Justice, Climate and Nitrogen Roadmaps
- Sustainability

HHRA Program Design

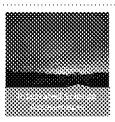
Implemented recommendations for stakeholder engagement in scoping and problem formulation



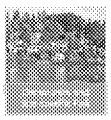
4 Topics and 9 HHRA Projects: Responding to Partner Priorities

1

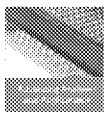

- #1) IRIS Assessments
- #2) IRIS Update

2


- #3) Integrated Science Assessments (ISAs) and Scientific/Regulatory Support

3


- #4) Provisional Peer-reviewed Toxicity Value (PPRTV) Assessments
- #5) Site-specific and Superfund Regulatory Support
- #6) Cumulative Risk Assessment Methods and Applications

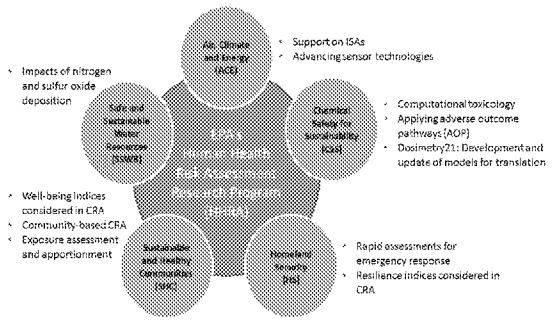
4


- #7) Advancing Hazard Characterization and Dose-response Methods and Models
- #8) Applying Emerging Science to Inform Risk Screening and Assessment
- #9) Risk Assessment Support and Training

Cross-Cutting Collaborations

HHRA Cross-Cutting National Program Work:

- **Chemical Safety for Sustainability (CSS) –** Application and characterization of new data, tools and concepts in risk screening and assessments; update of dosimetry modeling
- **Air, Climate and Energy (ACE) –** Incorporation of NAAQS research (including climate as a welfare effect) into Integrated Science Assessment (ISA); IRIS assessments of air toxics; interpretation of sensor data
- **Safe and Sustainable Water Resources (SSWR) –** Assessment of deposited oxides of nitrogen and sulfur on surface water quality
- **Sustainable and Healthy Communities (SHC) –** Development of Cumulative Risk Assessment (CRA) methods and decision analytic software to support "place-based" community assessment and to link health and ecology to well-being; evaluating epigenetics data
- **Homeland Security Research Program (HSRP) –** Rapid response assessment and incorporation of resiliency into cumulative risk assessment methods



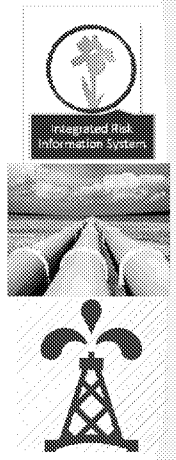
HHRA Program: People

- **NPD team**
  - **John Vandenberg,** National Program Director (NPD) ⟹ Transitioned to Tina Bahadori (NCEA CD)
  - **Annie Jarabek,** Deputy NPD ⟹ Transitioned to Senior Science Advisor (NCEA RTP)
  - **James Avery,** Assistant Center Director for Budget & Planning
  - **Lou D'Amico,** Communications Director (Acting)
  - **Ashley Jones and Salina Tewolde,** Science Communications
  - **Maureen Johnson,** HHRA Webmaster
- **HHRA Matrix Interface (MI)**
  - **NCEA: James Avery**
  - **NCCT: John Cowden**
  - **NERL: John Kenneke**
  - **NHEERL: Lisa Baxter**
  - **NHSRC: TBD**
  - **NRMRL: TBD**

- **Topic leads**
- **PL = Project leads**
- **TL = Task leads**
- **Regional partners (OHHRRAF, RSL)**
- **Program partners (OAR, OLEM, OW…)**

Topic 1: Integrated Risk Information System (IRIS)

- Topic 1 Lead: Kris Thayer / James Avery (acting) (NCEA-IRIS)
- Project 1 (*RMS HHRA 1.21*): IRIS Assessments
  [PLs Kris Thayer / James Avery, NCEA IRIS]
- Top-tier assessments support all program offices
  - **Components (e.g., systematic reviews) can be incorporated into various applications such as TSCA evaluations**
  - **Disciplinary working groups provide technical advice**
  - **Challenges feed into research projects**



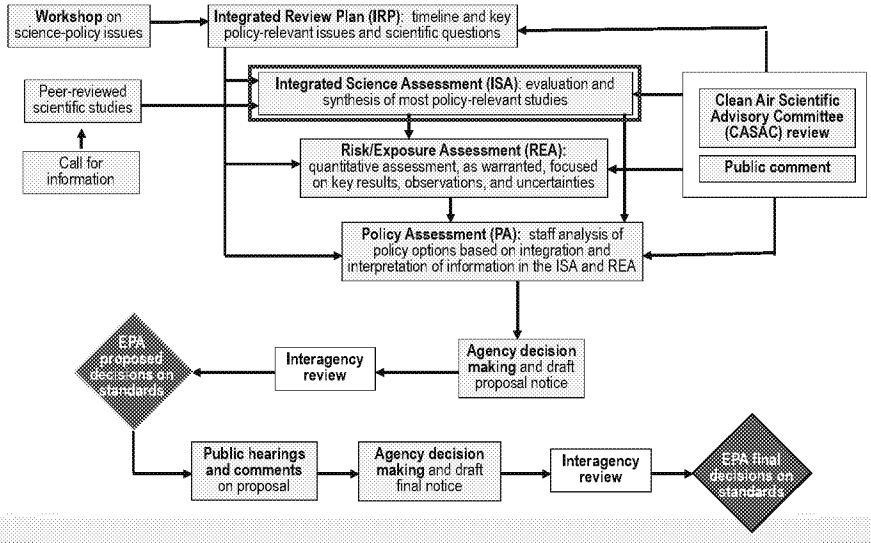
IRIS Project 1: Issues of Interest

- **IRIS Multi-year agenda**
  - Completed
  - Reflects program and regional priorities to aid planning
  - Scoping / problem formulation to be initiated on a few top priorities
- **IRIS Draft Handbook of Operating Procedures (IHOP)**
  - Evergreen and evolving
  - Systematic review and disciplinary workgroups to ensure quality, consistency
  - Enhancements to improve efficiency and productivity
- **Ingested inorganic arsenic and inhaled formaldehyde assessments**
- **Less-than-lifetime derivations**
- **Collaboration on components of IRIS assessments**

IRIS Project 2 (*HHRA 1.22*): Updating and Innovating

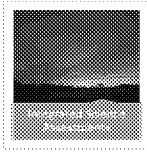
- **Purpose**
  - **Ensure IRIS and related portfolio of products provide premier risk assessment resource**
  - **Provide timely assessments that are focused on key questions**
  - **Pilot new applications**
  - **Streamline the review process**
- **Status**
  - **Approval by IOAA-ORD**
  - **Identify top EPA priorities (similar to process for IRIS multiyear agenda)**
  - **Top-priority updates underway: Mn, uranium, chloroform, ammonia**

National Ambient Air Quality Standard (NAAQS) Review Process



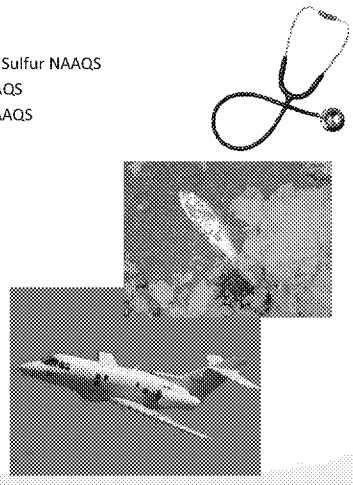
Topic 2: Integrated Science Assessments (ISA) and Scientific/Regulatory Support

- **Project 3 (*HHRA 2.21*) - ISAs and Scientific/Regulatory Support**
  PL: Steve Dutton, NCEA RTP
  - Development of ISA
    - Public science workshops
    - Draft and final Integrated Review Plans (IRPs) and ISAs
    - Public Clean Air Scientific Advisory Committee (CASAC) meetings
  - ISA-Related Scientific & Regulatory Support
  - ISA-Related Science Advancements
- **HHRA engagement**
  - Weekly meetings with OAQPS; monthly with others as needed



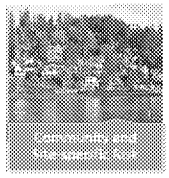
ISA-Related Scientific and Regulatory Support

- Scientific and Regulatory Support for the NAAQS
  - Support to OAR/OAQPS on the Risk and Exposure Assessment (REA) for the Oxides of Sulfur NAAQS
  - Support to OAR/OAQPS on the Policy Assessment (PA) for the Oxides of Nitrogen NAAQS
  - Litigation and decision support to OGC for Oxides of Nitrogen and Oxides of Sulfur NAAQS
- Regulatory and Policy Support for Other Programs
  - OAR/OAQPS (ecosystem critical loads; multipollutant science; health messaging)
  - EPA Roadmaps (nitrogen, children's health, climate)
  - SERDP/ESTCP (climate change proposal reviews)
  - NCCT (advancing risk assessment methodology)
  - S. Australia EPA & Taiwan EPA (presentations)
  - Health Effects Institute (liaison committee)
  - ORD/OSP (aircraft GHG and Pb emissions)
  - OAR/OTAQ (rulemaking support)
  - OPPT/OCSPP (azo dye transport)
  - NIEHS (exposure science)
  - OPP (systematic review)
  - **OW/OLEM (Pb modeling support)**
  - Regions (RARE)



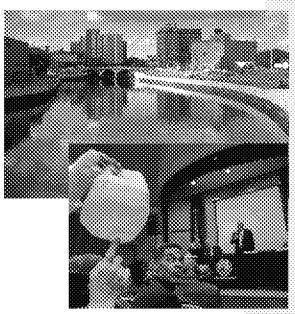
Project 4 (*HHRA 3.21*): Provisional Peer-reviewed Toxicity Value (PPRTV) Assessments

- Project 4 PL: Teresa Shannon, NCEA CIN
- Provisional Peer-Reviewed Toxicity Value (PPRTV) Assessments
  - Annually develop ≥ 12 PPRTV assessments as prioritized by OLEM.
    - Derived following a review of the relevant scientific literature using the same methods, sources of data, and guidance used by the IRIS program
    - All PPRTV assessments receive internal review by EPA scientists and external peer review by independent scientific experts.
  - Status FY17 Q2
    - pCBSA (para-chloro benzene sulfonic acid)
      - Chronic and subchronic oral RfD
    - Now 335 PPRTV assessment documents available online which provide 799 values
    - On target to deliver all in FY17 and FY18 already in process
  - FY17: Continued application of new approaches in appendices as characterization and understanding matures



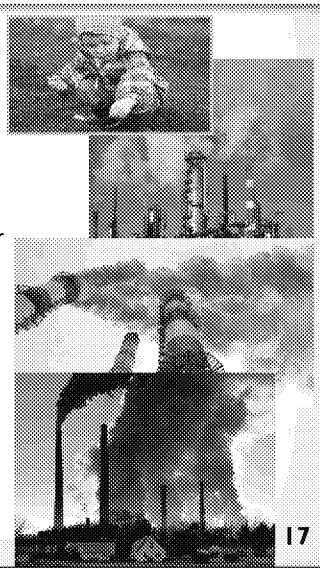
HHRA Project 5 (*HHRA 3.22*): Site-specific and Superfund Regulatory Support

- Project 5 PL: Teresa Shannon, NCEA CIN
- **Provides technical support, consultation and reviews for Superfund and other Agency priorities**
  - Quarterly reports to Superfund Technical Support Center (STSC) and Ecological Risk Assessment Support Center (ERASC)
  - Technical consultation and support on Agency priorities
    - Denka facility in LA: Chloroprene
    - Region 5, Manganese: Consultation to Region 5 regarding best exposure levels (reference values) to use for an enforcement action under consent decree that mandated fence-line monitoring at a facility in East Liverpool, OH
    - Tire crumbs
    - Health and education outcomes in R7 near former Pb refinery / smelter

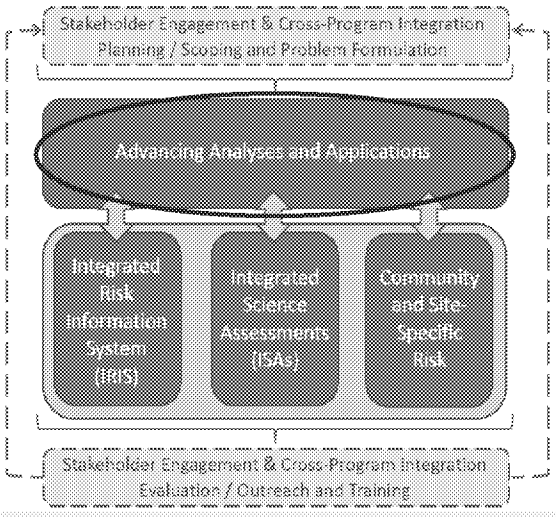


HHRA Project 5 (*HHRA 3.22*): Site-specific and Superfund Regulatory Support (cont)

- **Participation on Agency workgroups**
  - Soil and dust ingestion: NCEA W consultation on exposure factors in collaboration with SHC
  - OAQPS, n-Propyl Bromide (nPB): NCEA RTP Staff participated as a member of the nPB HAP-Listing Work Group convened by OAQPS
    - n-PB will be the first chemical to be added to the list of Hazardous Air Pollutants (HAPs) since the Clean Air Act 1990 amendments
    - On December 28, 2016, the US EPA issued a draft notice of the Agency's rationale for granting petitions to add nPB to the list of HAPs
  - OAQPS, Risk and Technology Review (RTR) Program: NCEA RTP staff participates as work group members on a number of RTR, source-category specific regulatory actions, working collaboratively with ORD/OSP to provide an ORD-wide perspective.
    - 33 new source categories will require a review by 2020



HHRA: Advancing New Analyses and Applications

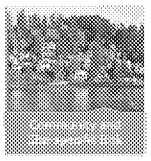


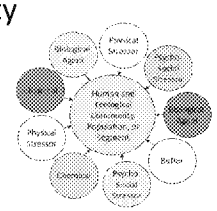
- **Highly leveraged projects to address challenges that arise in assessments**
- **Evaluation of emerging science**
- **Characterizing the application of new methods and data**

- Project 6 (*HHRA 3.23*) - Cumulative Risk Assessment (CRA) Methods and Applications

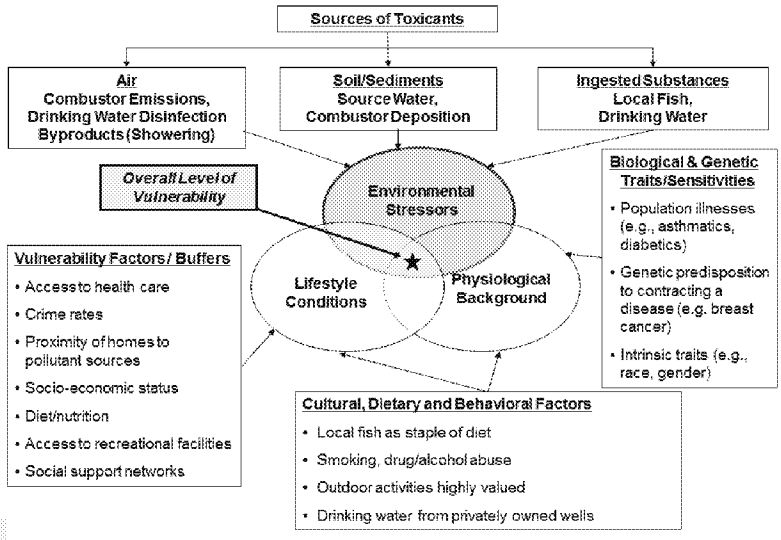
  PLs: Mike Wright, NCEA CIN / Deborah Segal, NCEA W

  - Approaches to cross-species data integration to support CRA
  - Incorporating multiple stressors
  - Applying Genetic and Epigenetic Data to Inform Susceptibility
  - Apportioning Multimedia Exposure and Risk Across Human and Ecological Receptors



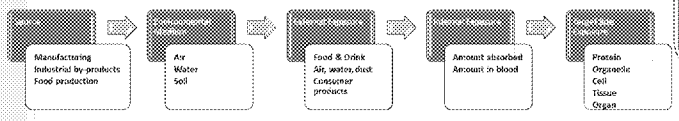


Cumulative Risk Assessment Conceptual Model



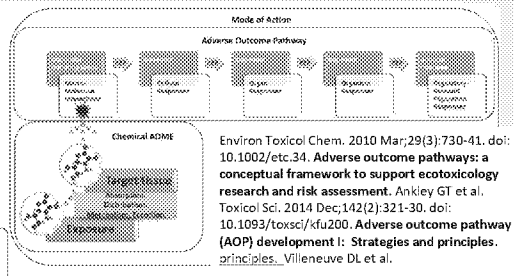
Project 6 (*HHRA 3.23*): Cumulative Risk Assessment Methods and Applications

- Approaches to cross-species data integration (collaboration with NHEERL)
  - Case studies illustrating utility of AEP:AOP frameworks to integrate human and ecological endpoints (e.g., the ES-GEAE) and advance mechanistic considerations



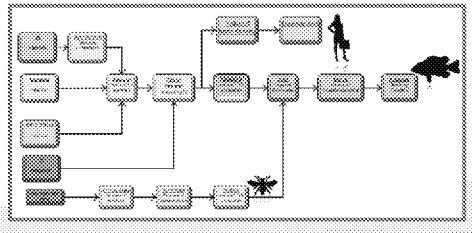
AEP: Aggregate Exposure Pathway

Environ Sci Technol. 2016 May 3;50(9):4579-86. doi: 10.1021/acs.est.5b05311. Epub 2016 Feb 10.
Completing the Link between Exposure Science and Toxicology for Improved Environmental Health Decision Making: The Aggregate Exposure Pathway Framework. Teeguarden JG; Tan YM; Edwards SW et al.



Environ Toxicol Chem. 2010 Mar;29(3):730-41. doi: 10.1002/etc.34. **Adverse outcome pathways: a conceptual framework to support ecotoxicology research and risk assessment.** Ankley GT et al.
Toxicol Sci. 2014 Dec;142(2):321-30. doi: 10.1093/toxsci/kfu200. **Adverse outcome pathway (AOP) development I: Strategies and principles.** principles. Villeneuve DL et al.

AOP: Adverse Outcome Pathway



Project 6 (*HHRA 3.23*): Cumulative Risk Assessment Methods and Applications

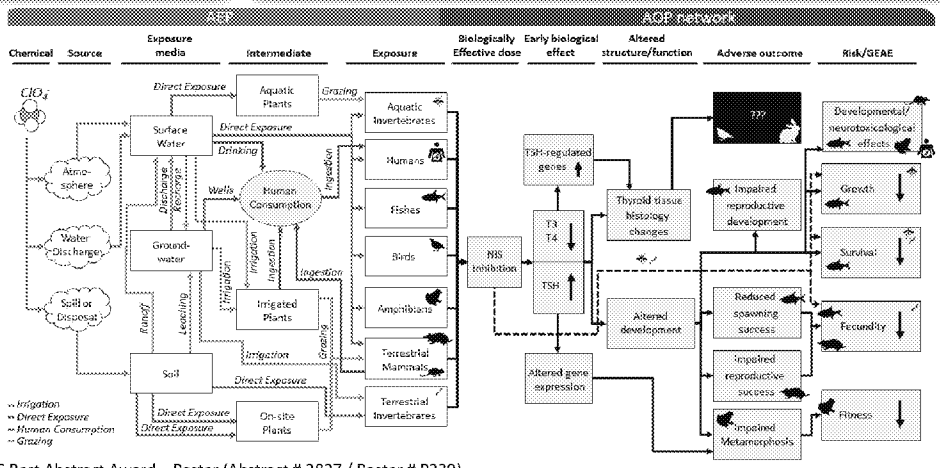
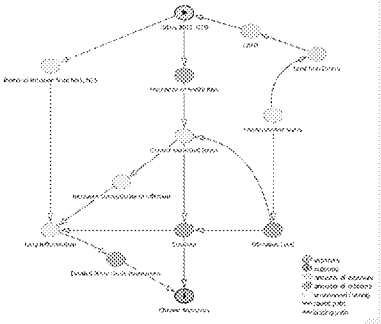


Figure 1: Perchlorate AEP-AOP construct for integration of human health and ecological endpoints into risk assessment.

SOT 2017 RASS Best Abstract Award – Poster (Abstract # 2827 / Poster # P229)
David Hines et al. *Cross-species integration of human health and ecological endpoints using the Aggregate Exposure Pathway (AEP) and Adverse Outcome Pathway (AOP) frameworks to advance risk assessment*

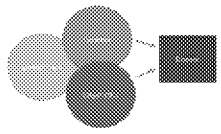
Project 6 (*HHRA 3.23*): Cumulative Risk Assessment Methods and Applications

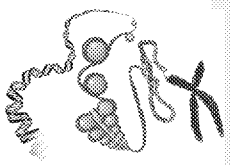
- Incorporating multiple stressors
  - Workshop report: Greenspace (GS) exposure and health effects occurrence from a CRA perspective. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=314417
  - Brewer LE, Wright JM, Rice G, Neas L, Teuschler L. (2017) Causal inference in cumulative risk assessment: The roles of directed acyclic graphs. *Environ. Int.* May;102:30-41. doi:10.1016/j.envint.2016.12.005. Epub 2016 Dec 14.
  - FY17/18: Additional case studies, including: Gernes R, Rice G, Wright JM, et al (In Preparation) Evaluation of Multiple Measures of Residential Greenspace Exposure and Early and Late-onset Allergy Outcomes in the Cincinnati Childhood Allergy and Air Pollution Study (CCAAPS) cohort.



Project 6 (*HHRA 3.23*) CRA (*continued*): Creating Context for Communities

- Applying Genetic and Epigenetic Data to Inform Susceptibility
  - **Applying Epigenetics Data to Cumulative Risk**
    - **Human Study:** Nonchemical Stressors, Epigenetic Changes, Susceptibility to Air Pollution Exposure, and Cardiovascular Disease *(HHRA, ACE, and SHC Collaboration with NHEERL on Duke CATHGEN project)*
      - *Currently running DNA methylation chips and anticipate completion of data collection in Spring*
    - **Literature Review:** Transgenerational Effects, Epigenetics, and Developmental and Reproductive Effects – *Implications for Chemical Testing and Risk Assessment*
    - **Epigenetics and Cumulative Risk Assessment Workshop Report**
  - **Applying Polymorphism and Mechanistic Data to Inform Genetic Susceptibility**
    - **Approach and Case Study:** Use AOP Framework and Select Relevant and Data Rich AOP for Case Study
      - Developing different approaches depending on available data with comparisons and advantages / disadvantages





Project 6 (*HHRA 3.23*) CRA (*continued*): Creating Context for Communities

- Apportioning Multimedia Exposure and Risk Across Human and Ecological Receptors
- Targeted to advance and apply methodologies for studying multiple stressor, multimedia exposures
  - SOT 2017 Poster (Abstract # / Poster #: 3536/P511): Reyes J and Price P. *An analysis of cumulative risks indicated by biomonitoring data of six phthalates using the maximum cumulative ratio.*
  - Two papers in progress:
    - Modeling cumulative risk from multiple phthalates exposures using the maximum cumulative ratio
    - Trends in NHANES phthalate data

Project 6 (*HHRA 3.23*): Cumulative Risk Assessment Methods and Applications

- Apportioning Multimedia Exposure *continued*: Cumulative exposures, social determinants, and health in Philadelphia
  - Collaboration with R3
  - Study addresses how to integrate non-chemical stressors in a community-level cumulative risk assessment (CRA), specifically by testing:
    - What social factors modify associations of health effects with chemical/non-chemical stressors
    - Why exposures to stressors may disproportionately burden vulnerable populations
  - Selected as one of four pilot studies of ORD Social-Environmental Science Exchange (SESE) and thereby receive assistance to
    - Design and implement focus groups related to perceptions of surrounding environment and factors that influence neighborhood environments
    - Address questions related to combining social and environmental data
    - Interpret results from focus groups in a larger context

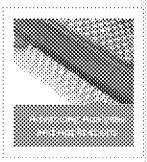
Topic 4: Advancing Analyses and Applications

- Topic 4 Leads: David Bussard / Scot Hagerthey (NCEA W)
  - Project 7 (*HHRA 4.21*) **Advancing Hazard Characterization and Dose-Response Methods**

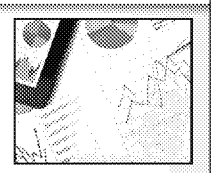
    PLs: Allen Davis, NCEA CIN / Andrew Kraft, NCEA W
  - Project 8 (*HHRA 4.22*) **Applying Emerging Science to Inform Risk Screening and Assessment**

    PLs: John Stanek, NCEA RTP / Jay Zhao, NCEA CIN
  - Project 9 (*HHRA 4.23*) **Risk Assessment Support and Training**

    PLs: Maureen Johnson, NCEA IO / Reeder Sams, NCEA RTP



Project 7 (*HHRA 4.2.1*): Advancing Hazard Characterization and Dose-response Methods

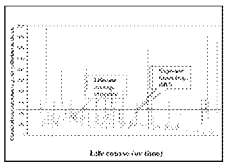


- **Advancing Methods for Systematic Review and Evidence Integration**
- **Advancing Quantitative Methods**
  - Bayesian epi meta-regression software – Significant software development as it represents a method that goes beyond existing published methods in several respects, but particularly with respect to an expansion of the types of studies that can be combined in a meta-regression analysis.
  - Model averaging methods – methods currently under development for model averaging (frequentist and Bayesian methods for continuous and dichotomous endpoints)
- **Advancing Methods for Benefits and Uncertainty Analyses**
  - Case study of exposure-response functions from epidemiology studies that illustrates methodologies showing how those functions can be presented to inform benefits analyses was drafted and shared with OP

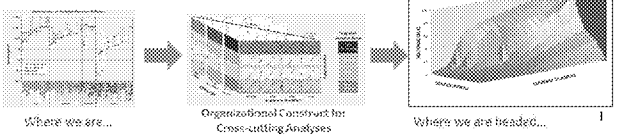
Project 7 (HHRA 4.21): Advancing Hazard Characterization and Dose-response Methods

- **Characterizing Determinants of Risk: Concentration, Duration and Timing of Exposure**
  - *Temporal Exposure Issues Workshop (January 2016)*
  - *Support to develop acute risk estimates recommended by BOSC*

- **Address different exposure scenarios: Create context for assessment approaches from acute and episodic exposures**
  - Characterize damage accumulation and/or irreversible effects
  - Define dose metrics and address trajectory of key events in AOP and different lesions along pathogenesis

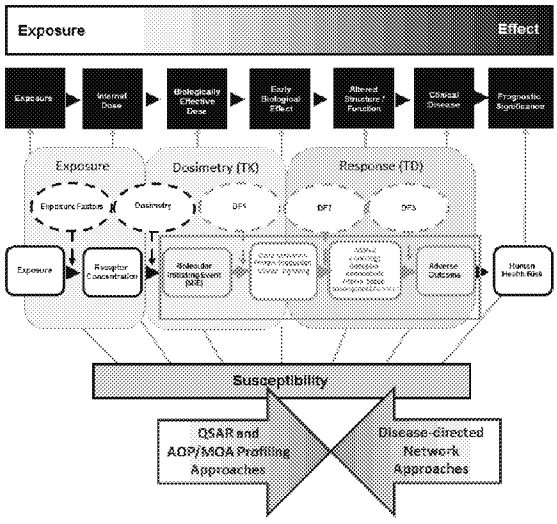


- **Case study approach across chemical categories / endpoints of concern**
  - Reactive gases / solvents / metals
  - Developmental / neurological



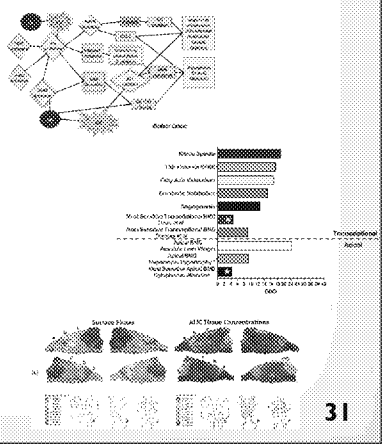
Creating Context for Evidence Integration and Evolution of Risk Assessment

- Convergence of conceptual frameworks
  - Biomarker
  - MOA
  - AOP
- Integration
  - Levels of organization
  - Key events across species
- Interoperable model components



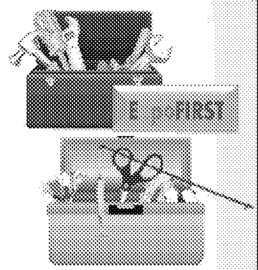
Building Confidence: Characterizing and Applying Emerging Science

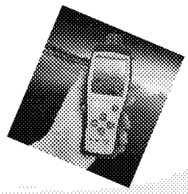
- **BOSC recommendation in July 2015: *Iterative and integrated* approach to foster understanding and trust of new techniques**
- **Anticipate expanded assessment portfolio in support of new TSCA as we characterize utility and as emerging applications mature**
  - Disease-based integration of new data types
    - Inorganic arsenic case study: Exploration of disease-based AOP
  - Characterization and Quantitative Application of High-throughput Screening (HTS) and Other Data-mining Derivations
    - Dean JL et al. (2017). Application of Gene Set Enrichment Analysis for Identification of Chemically-induced, Biologically Relevant Transcriptomic Networks and Potential Utilization in Human Health Risk Assessment. *Toxicol. Sci.* [Epub ahead of print] https://academic.oup.com/toxsci/article-lookup/doi/10.1093/toxsci/kfx021
  - Dosimetry21: Advancing Multi-scale Dosimetry Models to Incorporate AOP/MOA and Biomarker Data
    - Modernizing models to describe different dose metrics



Project 8 (HHRA 4.22): Applying Emerging Science to Inform Risk Screening and Assessment (*cont*)

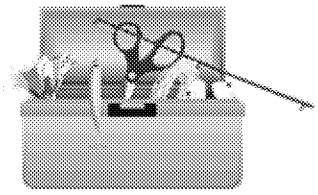
- **Evaluation and application of new exposure data and methods**
  - The updated Chapter 5 -Soil and Dust Ingestion of the Exposure Factors Handbook. External peer review expected in April / May.
  - Eco-Box: Addressing internal review comments. No release date due to hold on new websites.
  - Food Consumption tool: External peer review expected in May.
- **Advancing the Application of Sensor Data for Risk-Informed Decision Making**





What is EPA-Eco-Box?

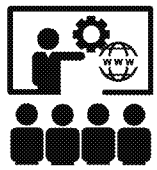
- Web-based compendium of links to ecological risk assessment tools
- One-stop shopping for ecological risk assessors
- Organized by Topic Areas
- User-friendly format
- Companion to EPA-Expo-Box
- Currently under development



To view draft website:
Login using your LAN/Wan ID and password at: https://wcms.epa.gov/user/login
Use the following link to access the draft website: https://wcms.epa.gov/ecobox

Advancing Analyses and Applications (cont.)

- Project 9 (*RMS HHRA 4.23*) – Risk Assessment Support and Training

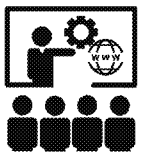


PLs: Maureen Johnson, NCEA IO / Reeder Sams, NCEA RTP

  - Development and maintenance of essential software and support tools (e.g, HERO, BMDS, ExpoBox, IRIS website)
  - Development and application of risk assessment training

HHRA Software, Support and Training

- HHRA homepage provides links to all projects: **http://intranet.ord.epa.gov/p2/hhra/home**
  - Integrated Risk Information System (IRIS) Website and database
  - Integrated Science Assessments (ISA) Websites and database
  - Provisional Peer-reviewed Toxicity Value (PPRTV) Website and database
- Health and Environmental Research Online (HERO) database (> 3 million references)
- Benchmark Dose Software (BMDS) Modeling website and training system
- EPA's-Expo-Box Website (EXPO-Box) and database
- Ecological Risk Assessment Support Center (ERASC) website
- Risk Assessment (Risk) Web Portal collection of human health risk assessments website and databases, including:
  - All-Ages Lead Model (AALM) Website
  - BioMarkers database
  - Database of Sources of Dioxin-like Compounds in the US
  - Dioxin Website and database
  - Epigenetics reference compilation
  - Next Generation of Risk Assessment (NexGen) website
  - Physiologically Based Pharmacokinetic (PBPK) modeling Website
  - Physiological Information (PID) database.



http://www2.epa.gov/risk

35

New landing page for all things risk provides link

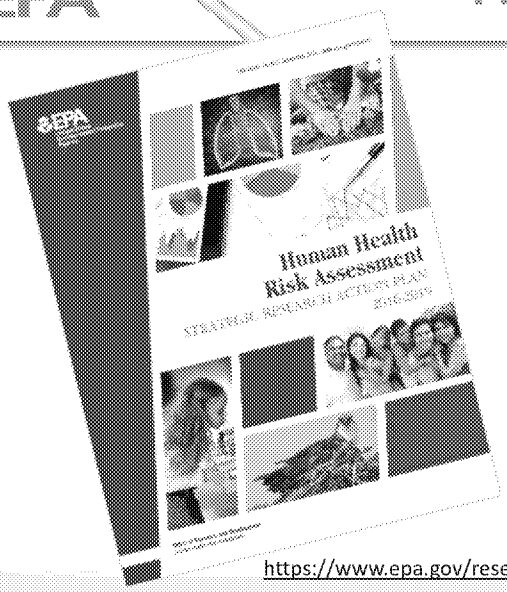
Risk Assessment Training and Experience (RATE) Program

- **Comprehensive training covering critical concepts**
  - Four primary areas of risk assessment.
  - Additional areas: Cumulative risk assessment (CRA), mixtures assessment, microbial risk assessment; Ecological Risk Assessment, risk management, risk communication, and new approaches in human health risk assessment
- **Modular to facilitate tailoring for specific needs**
- **Builds capacity to increase understanding and ensure transparency of assessment activities**
- **Diverse audience and interest indicates impact**
  - **Agency: Program and Region partners**
  - **Scientists working in various sectors around the globe**
    - **Interstate Technology and Regulatory Council (ITRC)-**Currently, all interested risk assessors in the United States and around the globe have free access to this important training material via http://www.itrcweb.org/risk-3/
    - **International** (Ghana, South Africa, Chile, Thailand, Egypt, Saudi Arabia, Dubai, Kuwait, Romania, Switzerland, Singapore, Australia and Canada)
  - **Professional societies: SOT, SRA-** General and specialized training in risk assessment (e.g., BMD)
  - **Academia: University of MD**-Graduate Course in Risk Assessment (MIEH 740: Environmental Risk Assessment)

Other HHRA Outreach and Technical Support

HHRA Bulletin	• Monthly to bi-monthly updates about all HHRA program activities • Membership grew from 0 in 2012 to 12,854 in November 2016
Benchmark Dose Software (BMDS)	• Periodic updates on new BMDS versions; including new categorical regression (CatReg) module, new developments activities such as model averaging, and training opportunities • Membership is 5,519 as of November 2016
IRIS	• Updates as needed on IRIS Program activities • Membership grew from 700 in 2012 to 3,287 in November 2016
EPA-Expo-Box	• Periodic messages on updates, new features and helpful tips; most recent message sent September 2016 to announce release of ExpoFIRST • Membership grew from 0 in 2013 to 1,215 in November 2016

Program Summary



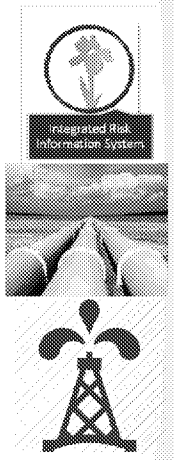
- **Provides a portfolio of assessment products for improved public health**
- **Identifies issues and advances approaches to arrive at solutions**
- **Applies new technologies and data to refine analyses**
- **Supports communities with cumulative risk characterization of multiple stressors on human and ecological health**
- **Educates and engages stakeholders to build capacity**

https://www.epa.gov/research/strategic-research-action-plans-2016-2019

Supplemental Slides

Topic 1: Integrated Risk Information System (IRIS)

- Project 1 (*RMS HHRA 1.21*) - IRIS Assessments [PLs Kris Thayer / James Avery, NCEA IRIS]
  - Task 1.211: Developing IRIS Document Components
  - Task 1.212: IRIS Science advancements & technical consultations
  - Task 1.213: Stakeholder engagement & outreach for IRIS Program **(TL Lou D'Amico, NCEA IRIS)**
  - Task 1.214: IRIS Handbook of Operating Procedures
- Project 2 (*RMS HHRA 1.22*) - IRIS Updates
  - Task 1.221: Develop decision strategy
  - Task 1.222: Review and update IRIS Assessments



Task 3.1 (*HHRA 2.211*) Development of ISAs

- FY17 Q1
  - Second draft ISA to support primary (health criteria) NAAQS for oxides of sulfur
    - Released Dec 2016
    - CASAC review Mar 20-21, 2017
    - NOTE: Exposure chapter well received
  - Final IRP to support primary and secondary (welfare criteria) NAAQS for particulate matter
    - Released Dec 2016 by OAQPS with ISA chapter developed by NCEA
    - Working on first draft ISA

- FY17 Q2
  - Final IRP to support secondary (ecological criteria) NAAQS for oxides of nitrogen, oxides of sulfur, and particulate matter
    - Released Jan 2017 by OAQPS with ISA chapter developed by NCEA
  - First draft ISA to support secondary (ecological criteria) NAAQS for oxides of nitrogen, oxides of sulfur, and particulate matter
    - CASAC review scheduled for May 24-25, 2017

Task 3.3 (*HHRA 2.213*) ISA-Related Science Advancements

- FY17 Q1 and Q2
  - Subtask 3.3.1 (2.213.1) Publications and Scientific Analyses
    - Sparks, A., A. Smith, A. Talhelm, C. Kolden, K. Yedinak, and D. Johnson. Impacts of fire radiative flux on mature Pinus ponderosa growth and vulnerability to secondary mortality agents (International Journal of Wildland Fire. DOI:10.1071/WF16139)
    - Owens, B., M. Patel, E. Kirrane, T. Long, J. Brown, I. Cote, M. Ross, and S. Dutton. Framework for assessing causality of air pollution-related health effects for reviews of the National Ambient Air quality Standards (submitted)
    - Xia, M., A. Talhelm, and K. Pregitzer. Long-term simulated atmospheric nitrogen deposition alters leaf and fine root decomposition (submitted)
    - Deener, K., J. Sacks, E. Kirrane, B. Glenn, M. Gwinn, T. Bateson, and T. Burke. Epidemiology: A Foundation of Environmental Decision-Making (submitted)
    - Chan, E., and J. Currier. Zinc and zinc-dependent proteins in cancer and chemotherapeutics. Molecular and Cellular Toxicology (submitted)
    - Richmond-Bryant, J., M. Snyder, C. Owen, and S. Kimbrough. Factors associated with near-road NO2 concentration gradient size (in clearance)
  - Presentations
    - 16 presentations at national and international conferences

Project 8 (*HHRA 4.22*): Applying Emerging Science to Inform Risk Screening and Assessment

- **Task 8.1 (*HHRA 4.221*) Disease-based Data Integration** (TL Ila Cote)
  - Focus has been inorganic arsenic assessment
    - Manuscripts in preparation on various disease outcomes
    - SOT 2017 Poster (Abstract # 2808 / Poster # P210) Druwe et al. Using Data Science to Identify at-Risk Subpopulations Exposed to Ground Water Contaminants: A Case Study of AS3MT in US-Mexican Mestizos and Arsenic Exposure
  - Future work will expand on above approaches and explore other applications of AOP
    - SOT 2017 Poster (Abstract # 2825 / Poster # P227) Jarabek and Harkema. Adverse Outcome Pathway (AOP) for ILC2-mediated Respiratory Epithelial Dysregulation and Remodeling Demonstrated by Inhaled Ozone and Chlorine
    - SOT 2017 Poster (Abstract # 2826 / Poster # P228): Clippinger et al. A Mechanistic Approach Using Adverse Outcome Pathways (AOPs) to Aid Design of *In Vitro* Inhalation Testing

EPA-Eco-Box Features

- Annotated Links to Over 400 Tools
  - Databases
  - Models
  - Guidance documents
  - References
- Organized into 4 Tool Sets
  - Stressors
  - Exposure Pathways
  - Receptors and Exposure Factors
  - Effects
- Search Interface
- Additional Resources
  - Basic information
  - Frequently asked questions
  - Join mailing list
  - Contact us / provide suggestions